

# Spectrometer Momentum Resolution Study

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# Reason for the Study

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- When we re-fit the sample of muon charged current events, we found that the calculated momenta were not in very good agreement with the true momenta. (See MC\_STUDY.pdf)
- Byron agreed to generate a sample of single muon events to see if there was an obvious problem in the Monte Carlo (i.e. alignment or something ?).

## Goals for this study

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- Compare the calculated and true momentum for single muon Monte Carlo events.
- Calculate the resolution,  $\Delta p/p$  :
  - $p$  = true momentum (GeV/c)
  - $\Delta p = p_{\text{calc}} - p_{\text{true}}$
- Look for trends or other pathologies in :
  - $\Delta p$  vs.  $p_{\text{true}}$
  - $\Delta p/p$  vs.  $p_{\text{true}}$

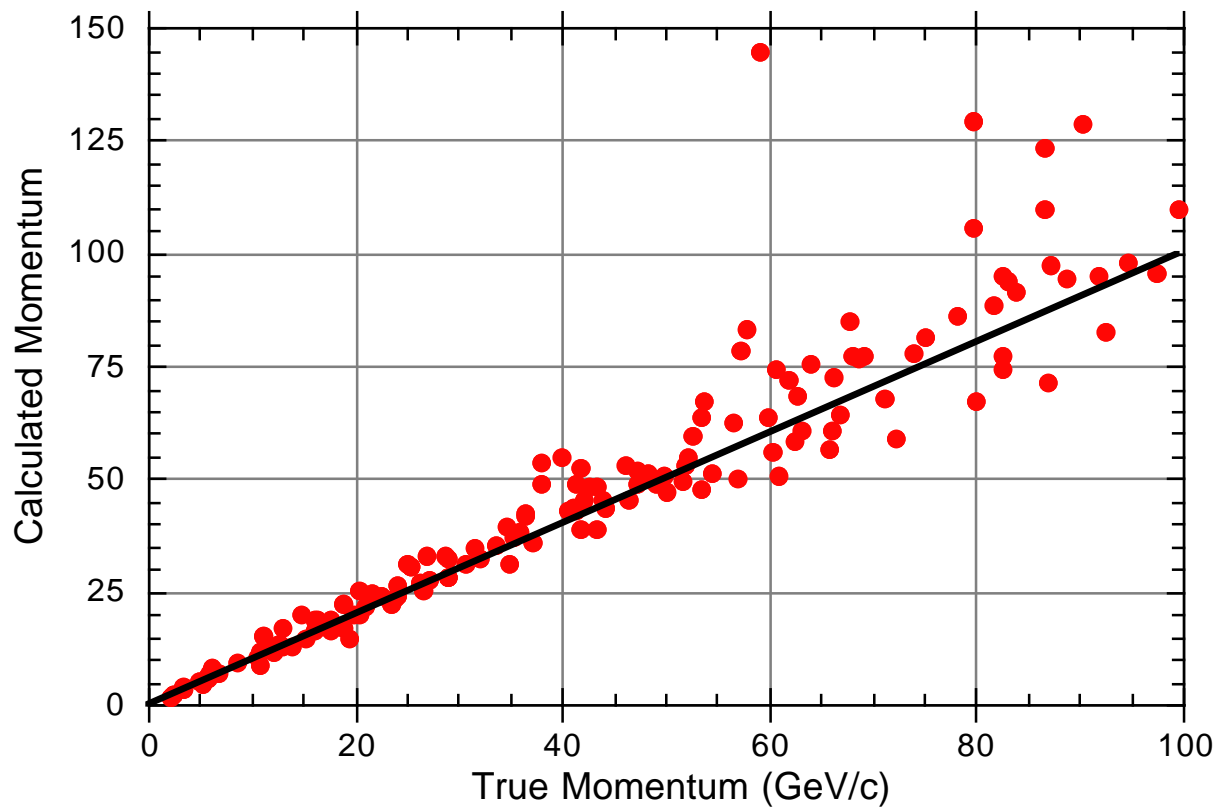
# Monte Carlo Study

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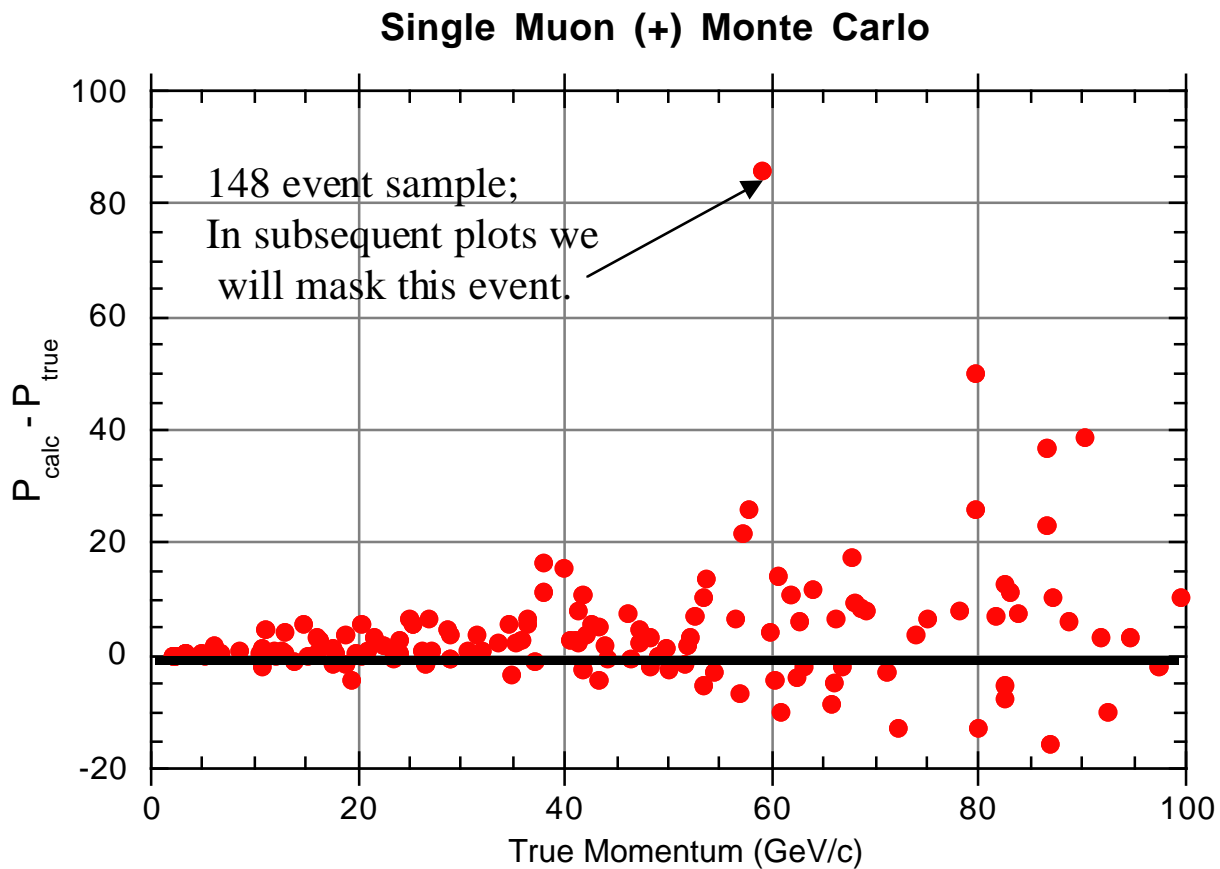
- Event Samples
  - Two sets of single muon Monte Carlo events were generated
    - 148 events in (+) sample
    - 148 events in (-) sample
- Momentum Range
  - Event momentum ranged from 3 to 98 GeV/c

# Calculated vs. True Momentum

## *Positive Momentum Single Muons*



# Momentum Error vs. True Momentum



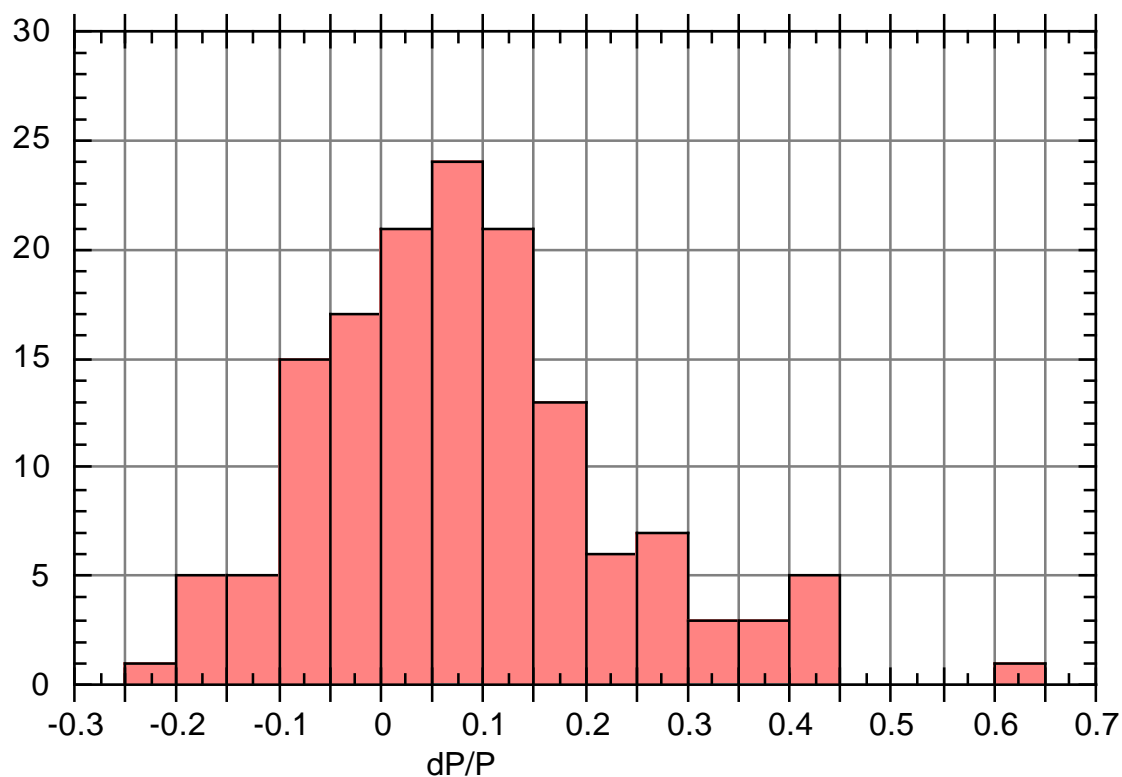
In this sample we see that there is a definite skewness toward a *positive* momentum error.

# Momentum Resolution (Monte Carlo Study)

148 events in sample  
(1 masked event not  
included in this plot)

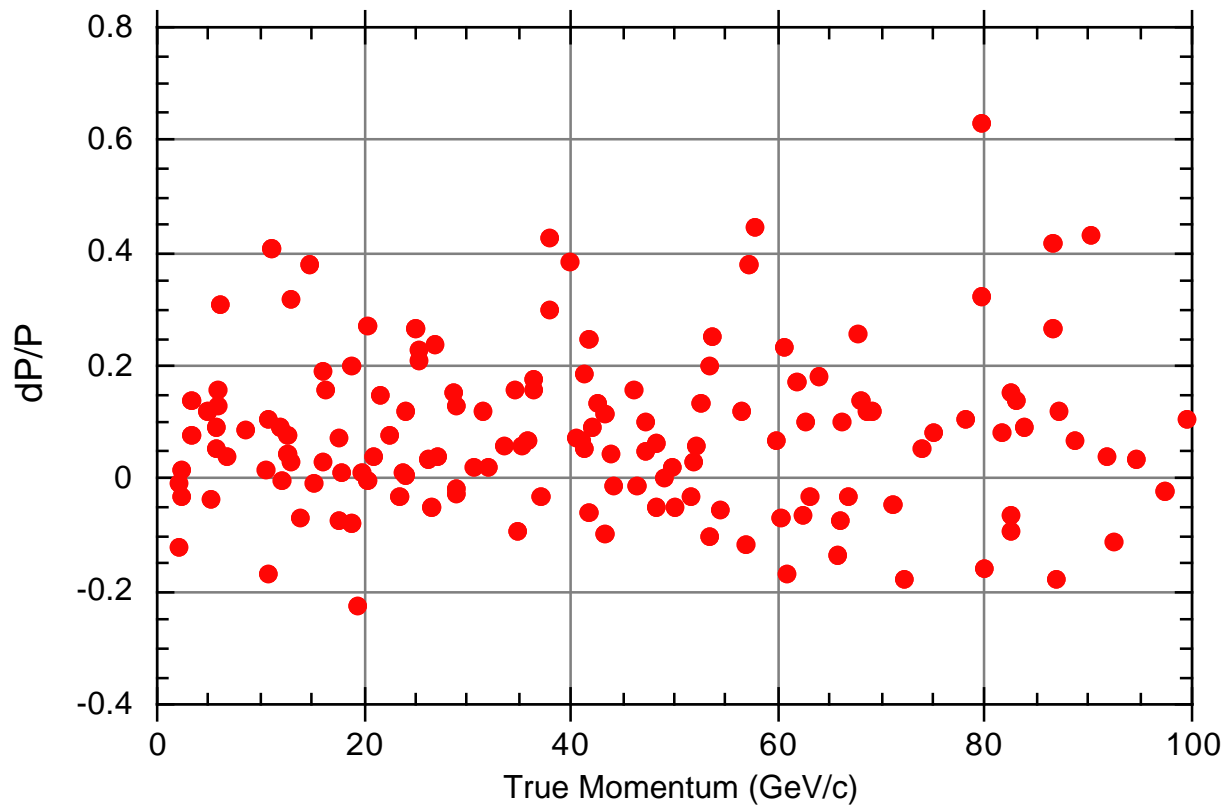
*Positive muon  
sample*

	dP/P
Minimum	-0.224
Maximum	0.630
Points	147
Mean	0.081
Median	0.069
RMS	0.165
Std Deviation	0.144



# Momentum Resolution (Monte Carlo Study)

## Resolution vs. true momentum

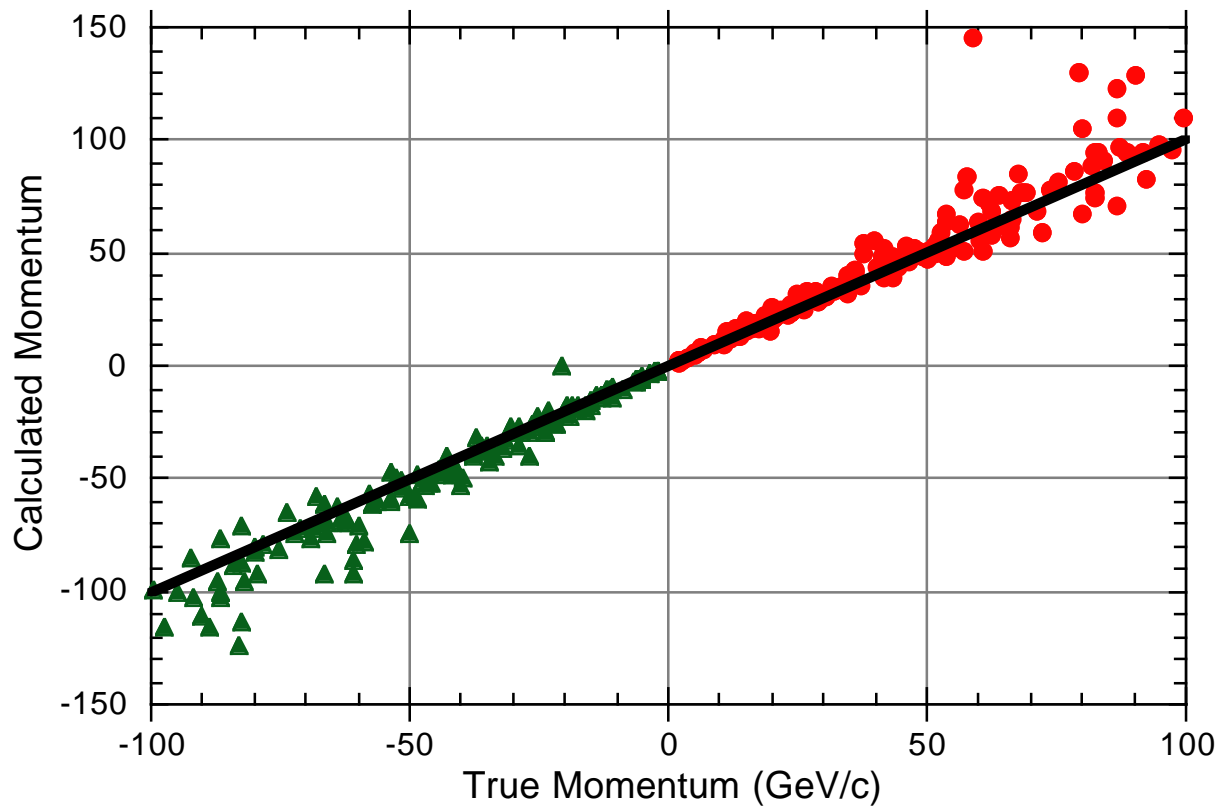


148 events in sample  
(1 masked event not  
included in this plot)



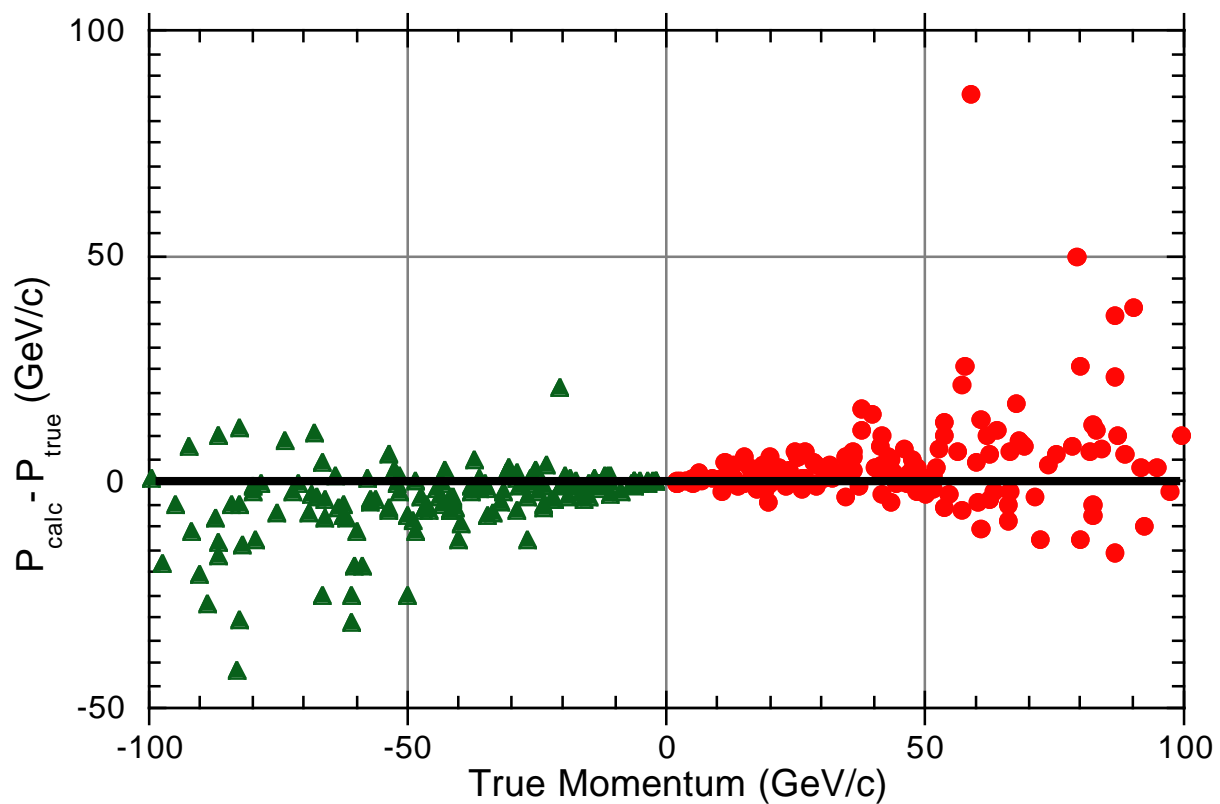
# Momentum Resolution (Monte Carlo Study)

148 *negative momentum* muons added to the sample :



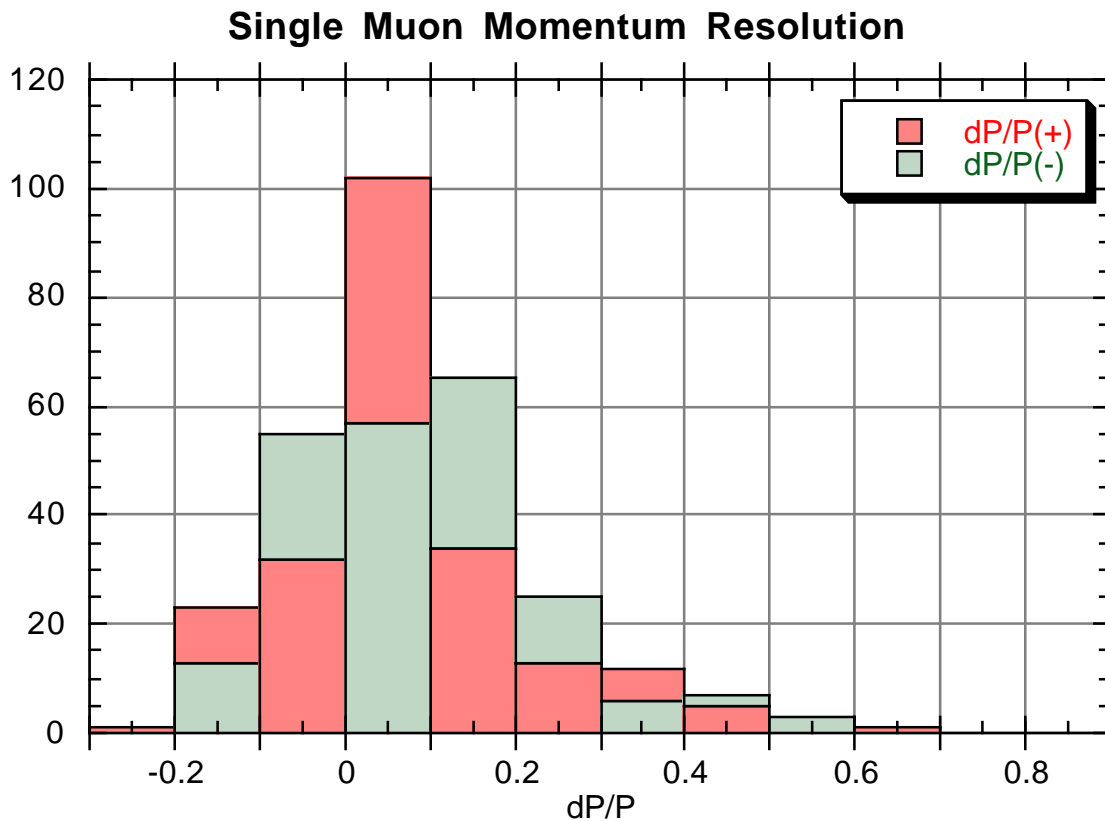
# Momentum Error

*positive* and *negative* event sample :



We see that the skewness appears to be the same in both samples - we **calculate** a **larger** than true **magnitude** of the momentum.

# $\Delta P/P$ for Single MC Muons



	dP/P(+)	dP/P(-)
Minimum	-0.224	-0.162
Maximum	0.630	0.509
Points	147	147
Mean	0.081	0.079
Median	0.069	0.059
RMS	0.165	0.155
Std Deviation	0.144	0.134

Conclusion :

Magnitude ~ 8% high;

Resolution ~ 15%